Ring-Ringlet Interactions in Saturn's C Ring

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The overall objective of this work is to derive a theoretical model for the formation of gaps harboring isolated ringlets in order to explain the presence of such features in Saturn's C ring and Cassini division.

Numerical simulations by Hanninen and Salo (1994, 1995) indicate that ringlets similar to those found in Saturn's C ring are able to form at isolated Lindblad resonances. Goldreich, Rappaport and Sicardy (1995) demonstrated that the reversal of angular momentum luminosity associated with the perturbations exerted near a Lindblad resonance is responsible for the collection of ring particles into a ringlet.

This presentation will deal with the following questions: what is the reason for the confinement of the gap's edges? Can an eccentric ringlet within a gap exert an appreciable torque on the gap's edges? Can the main inner ring balance or at least slow down the inward drift of the ringlet associated with unbalanced satellite torque?

We studied the gravitational perturbations exerted by the narrow ringlet on a test particle orbiting near one of the gap's edges and the exchange of angular momentum between the ringlet and the main surrounding ring. We found that the ringlet torque is able to confine only the inner edge of the gap.

We applied these results to the ringlet and gap at 1.470 Rs in Saturn's C ring. We found that if the ringlet's shape is dominated by the $m = 1$ mode, then its surface density would have to be much smaller than generally thought, otherwise the perturbations exerted on the edges would have been observed in the Voyager data. If the ringlet's eccentricity is forced by the 2:1 Lindblad resonance with Prometheus, as suggested by Goldreich, Rappaport and Sicardy's explanation, then the perturbations exerted by the ringlet on the gap's edges are of the same order of magnitude as those exerted by Prometheus. Similarly, the magnitude of the ringlet torque is of the same order of magnitude as the magnitude of the satellite torque.

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